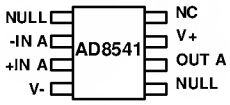
Low Power, Ultra Low Bias Rail-to-Rail Amplifier

Preliminary **AD8541/42/44**

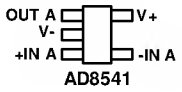
FEATURES
Single-Supply Operation: 2.7 to 5.5 Volts
Low Supply Current: 40 µA/amplifier
Wide Bandwidth: 500 kHz
Slew Rate: 0.5 V/µs
No Phase Reversal
Low Input Currents: 4 pA
Unity Gain Stable

APPLICATIONS
Medical Instrumentation
Integrators
ASIC Input or Output Amplifier
Piezio Electric Transducer Amplifier

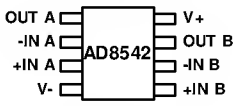
8-Lead SO (R Suffix)



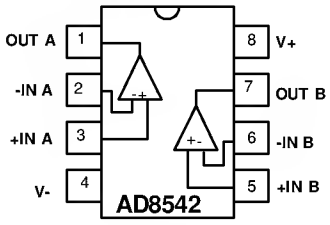
5-Lead SOT (RT Suffix)



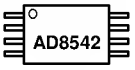
8-Lead SO (R Suffix)



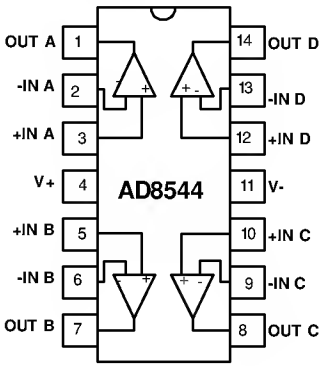
8-Lead Epoxy DIP (N Suffix)



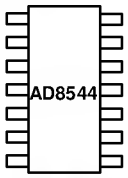
8-Lead TSSOP (RU Suffix)



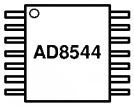
14-Lead Epoxy DIP (N Suffix)



14-Lead Narrow-Body SO (N Suffix)



14-Lead TSSOP (RU Suffix)



Note: Pin orientation is equivalent for each package variation

GENERAL DESCRIPTION

The AD8541, AD8542 and AD8544 are single, dual and quad **rail-to-rail input and output** single-supply amplifiers featuring ultra low bias current. All are guaranteed to operate from a **+3 volt single supply** as well as a +5 volt supply.

Very low input bias currents enable the AD854X to be used for integrators, diode amplification or applications with a very high source impedance. Supply current is only 40 µA per amplifier, ideal for battery operation or designs where power must be supplied across an isolation barrier. High output current combined with low power and no phase reversal makes the AD854x family a good choice for 4 to 20 mA applications.

Rail-to-rail inputs and outputs are beneficial to designers buffering CMOS DACs, ASICs or other wide output swing devices in single-supply systems.

The AD8541, AD8542 and AD8544 are specified over the extended industrial (-40° to +125°C) temperature range. The AD8541 is available in SO-8 and SOT23-5 packages. The AD8542 is available in 8-pin plastic DIPs, SO-8 and 8-lead TSSOP surface mount packages. The AD8544 is available in 14-pin plastic DIPs, narrow SO-14 and 14-lead TSSOP surface mount packages. All TSSOP and SOT versions are available in tape and reel only

REV. 0

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Fax: 617/326-8703

ELECTRICAL CHARACTERISTICS (@ V_S = +3.0V, V_{CM} = 1.5V, T_A= +25°C unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	mV
		-40°≤ T_A ≤ +85°C				mV
Input Bias Current	I_B			0.1	4	pA
		-40°≤ T_A ≤ +85°C				pA
Input Offset Current	I_{OS}			0.1	2	pA
		-40°≤ T_A ≤ +85°C				pA
Input Voltage Range			0		3	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 to 3V	65	75		dB
Large Signal Voltage Gain	A_{VO}	R_L = 100kΩ , V_O= 0.5 to 2.5V	100			V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			2		µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$					fA/°C
Offset Current Drift	$\Delta I_{OS}/\Delta T$					fA/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = µA	2.85	2.92		V
		-40°C ≤T_A ≤ +85°C	2.8			V
Output Voltage Low	V_{OL}	I_L = µA		60	100	mV
		-40°C≤T_A ≤ +85°C			125	mV
Output Current	I_{OUT}			±10		mA
Closed Loop Output Impedance	Zout	f = 1MHz, A_V = 1				Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.5V to 5.5V	70	85		dB
Supply Current/Amplifier	I_{SY}	V_O = 0V		35	50	µA
		-40°≤ T_A ≤ +85°C			70	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 100kΩ	0.4	0.6		V/µs
Settling Time	t_s	To 0.01%		8		µs
Gain Bandwidth Product	GBP			500		kHz
Phase Margin	Øo					degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1kHz		100		nV/√Hz
Voltage Noise Density	e_n	f = 10kHz		90		nV/√Hz
Current Noise Density	i_n					pA/√Hz

Specifications subject to change without notice.

ELECTRICAL CHARACTERISTICS (@ V_S = +5.0V, V_{CM} = 2.5V, T_A= +25°C unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	mV
		-40°≤ T_A ≤ +85°C				mV
Input Bias Current	I_B			0.1	4	pA
		-40°≤ T_A ≤ +85°C				pA
Input Offset Current	I_{OS}			0.1	2	pA
		-40°≤ T_A ≤ +85°C				pA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 to 5V	75	80		dB
Large Signal Voltage Gain	A_{VO}	R_L = 100kΩ , V_O=0.5 to 4.5V	300			V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	-40°≤ T_A≤ +85°C		2		µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$					fA/°C
Offset Current Drift	$\Delta I_{OS}/\Delta T$					fA/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 10µA	4.9	4.94		V
		-40°C≤T_A ≤ +85°C	4.85			V
Output Voltage Low	V_{OL}	I_L = 10µA		50	100	mV
		-40°C≤T_A ≤ +85°C			125	mV
Output Current	I_{OUT}			±25		mA
Closed Loop Output Impedance	Zout	f = 1kHz, A_V = 1				Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.5V to 5.5V	70	85		dB
Supply Current/Amplifier	I_{SY}	V_o = 0V		40	60	µA
		-40°≤T_A ≤ +85°C			80	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 100kΩ, C_L = 200pF	0.5	0.7		V/µs
Full-Power Bandwidth	BW_p	1% Distortion				kHz
Settling Time	t_s	To 0.01%		6		µs
Gain Bandwidth Product	GBP			700		kHz
Phase Margin	Øo					degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1 kHz		90		nV/√Hz
Voltage Noise Density	e_n	f = 10 kHz		80		nV/√Hz
Current Noise Density	i_n					pA/√Hz

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_S) ..... +6V
Input Voltage..... Gnd to V_S
Differential Input Voltage[1]..... ±6V
Storage Temperature Range
N, R, RT, RU Package ..... -65°C to +150°C
Operating Temperature Range
AD8541, AD8542, AD8544 ..... -40°C to +85°C
Junction Temperature Range
N, R, RT, RU Package ..... -65°C to +150°C
Lead Temperature Range (Soldering, 60 Sec) ..... +300°C

PACKAGE INFORMATION

Package Type	θ_{JA}[2]	θ_{JC}	Units
5-Lead SOT-23 (RT)			°C/W
8-Pin SOIC (R)	158	43	°C/W
8-Pin TSSOP (RU)	240	43	°C/W
14-Pin Plastic DIP (N)	83	39	°C/W
14-Pin SOIC (R)	120	36	°C/W
14-Pin TSSOP (RU)			°C/W

NOTES

[1] For supplies less than +6 volts, the differential input voltage is equal to $\pm V_S$.

[2] θ_{JA} is specified for the worst case conditions, i.e., θ_{JA} is specified for device in socket for P-DIP packages; θ_{JA} is specified for device soldered onto a circuit board for surface mount packages.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8541AR	-40°C to +85°C	8-Pin SOIC	SO-8
AD8541ART†	-40°C to +85°C	5-Lead SOT-23	RT-5
AD8542AR	-40°C to +85°C	8-Pin SOIC	SO-8
AD8542AN	-40°C to +85°C	8-Pin Plastic DIP	N-8
AD8542ARU*	-40°C to +85°C	8-Pin TSSOP	RU-8
AD8544AR	-40°C to +85°C	14-Pin SOIC	SO-14
AD8544AN	-40°C to +85°C	14-Pin Plastic DIP	N-14
AD8544ARU*	-40°C to +85°C	14-Pin TSSOP	RU-14

* Available in 2,500 piece reels only.

† Available in 3,000 or 10,000 piece reels.